

Additive Manufacturing of Magnesium (Mg) Alloys

Completed Technology Project (2014 - 2015)



Project Introduction

The proposed work is to investigate additive manufacturing techniques for Mg alloys. It will leverage off research being conducted at University of Florida and Kennedy Space Center to develop these alloys and evaluate their properties.

Mg alloys as a class have higher specific strength than either steel or aluminum and offer potential for reducing weight in spacecraft. Mg has been approved by Federal and Joint Aviation standards and NASA standards state that it can be used in areas that are not prone to corrosion. Thus, the proposed applications include the skin or cladding within structural members or on non-oxidizing environments such as Mars. In addition Mg alloys can be recycled, meaning that they can be refabricated into lunar and planetary habitats.

The proposed work is to investigate additive manufacturing techniques for these alloys. It will leverage off research being conducted at University of Florida and Kennedy Space Center to develop these alloys and optimize their properties. The proposed work is designed as a one-year study to formulate an approach to use additive manufacturing to fabricate novel parts and recycle these alloys.

Mg alloys are traditionally cast then extruded and/or machined to final shape, producing many parts economically. However, these techniques are not as amenable to producing thin-gage parts and claddings proposed for space applications. Development of additive manufacturing (AM) techniques offers a novel fabrication approach, easily producing cladding and thin-gage skins as well as incorporating these alloys into compositionally-graded structures. A space-based AM system can also exploit Mg recyclability to produce lunar and planetary habitats from Mg space vehicles.

Electron beam freeform fabrication (EBF³) is an excellent candidate for AM of Mg alloys. Unlike many AM techniques using powder pre-form, its metallic wire precursor offers a much safer way to handle Mg alloys, and it naturally lends itself to the large-scale production of claddings and chemically graded parts. EBF³ is also being investigated for on-orbit and planetary use, and development of parameters for Mg production would be a large step toward the future recyclability of these materials during space exploration missions.

The aim of this project is to demonstrate the feasibility of fabricating Mg alloy structures using additive manufacturing techniques. Testing will consist of fabricating and characterizing Mg parts using LaRC's EBF³ facility.

Anticipated Benefits

Reduced cost and structural weight



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Center Innovation Fund: LaRC CIF

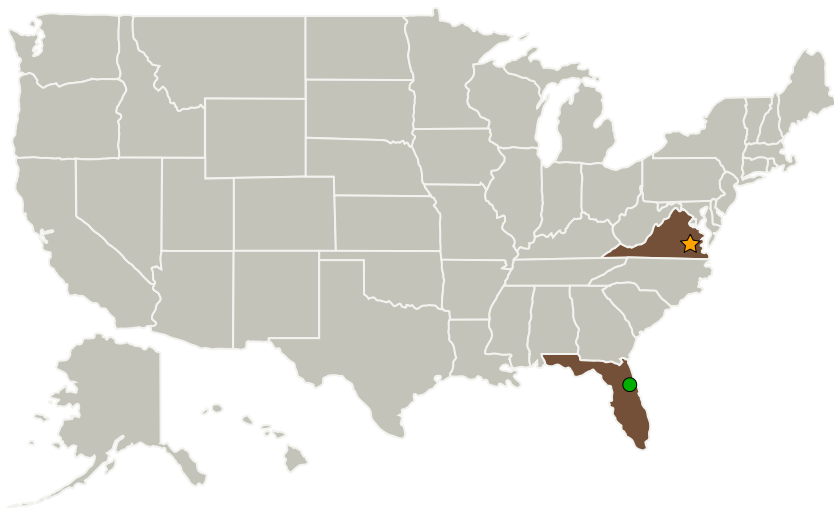
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Reduced cost and structural weight

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
● Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations

Florida	Virginia
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Project Management

Program Director:

Michael R Lapointe

Program Manager:

Julie A Williams-byrd

Principal Investigator:

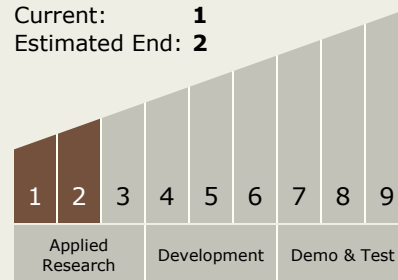
Terry A Wallace

Technology Maturity (TRL)

Start: 1

Current: 1

Estimated End: 2



Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
 - TX03.1 Power Generation and Energy Conversion
 - TX03.1.5 Electrical Machines